White-Nose Syndrome: A Diagnostic Summary

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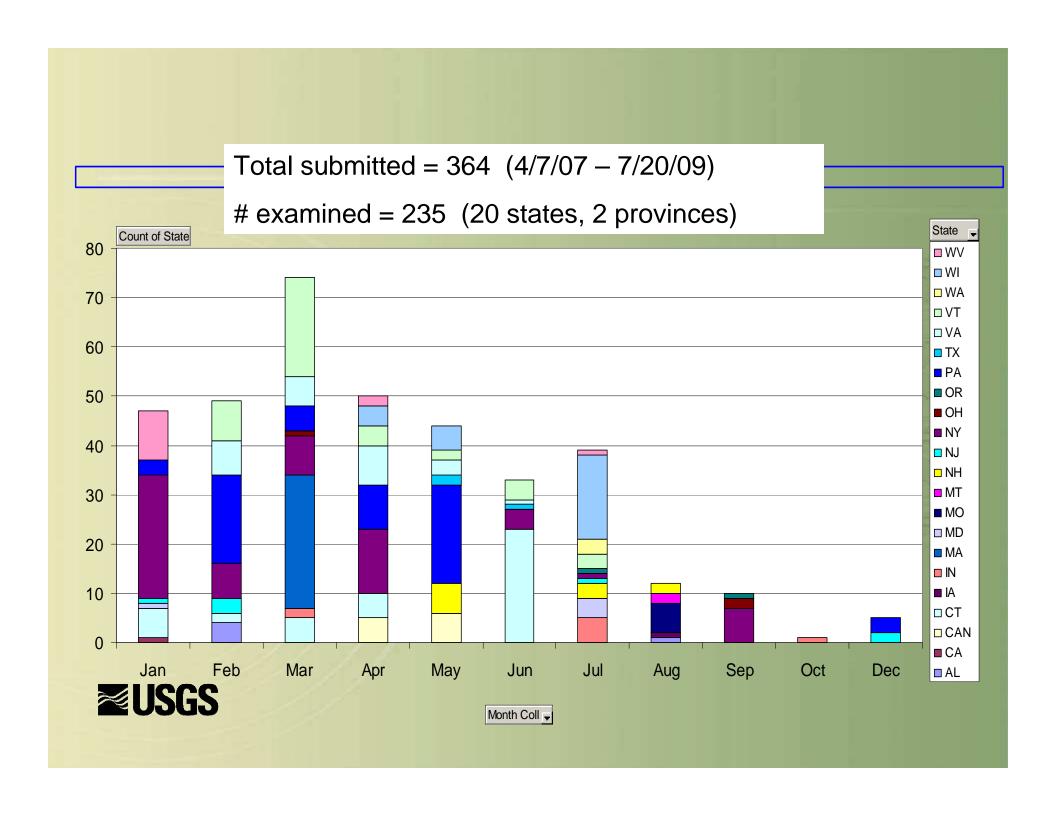
USGS - National Wildlife Health Center





U.S. Department of the Interior

U.S. Geological Survey



Field Definition

- Winter
 - Cave hibernating, insectivorous species
 - Abnormal behaviors
 - day flight activity, delayed arousal, roosting near entrance
 - Bat mortality
 - Visible fungus (muzzles, ears, flight membranes)
 - Emaciation/dehydration?
 - Wing damage
- Summer?





Parasitology, Virology, and Bacteriology

- Parasitology: Disease causing parasites not found.
- Virology: No known viral pathogens identified.
- Bacteriology: No consistent findings.



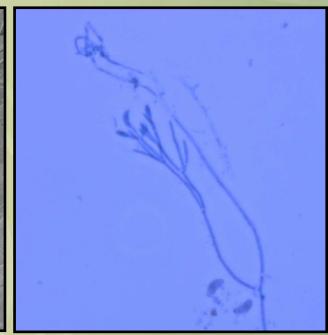




Circumstantial Case from Direct Observation



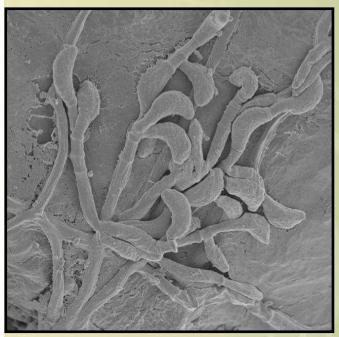
Fixed Bat Muzzle Skin NYS DOH Photo by D. Springer and M. Behr



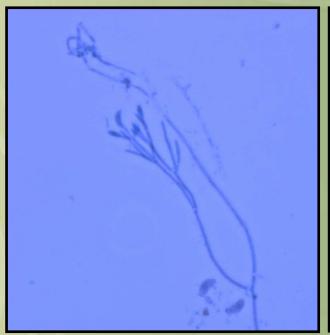
Direct Scraping from Bat NYS DOH Photo by M. Behr



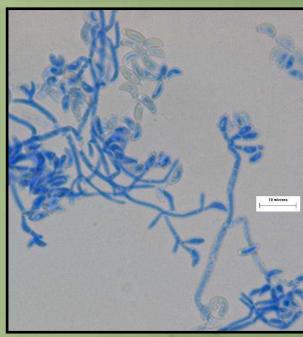
Circumstantial Case from Direct Observation



Fixed Bat Muzzle Skin NYS DOH Photo by D. Springer and M. Behr



Direct Scraping from Bat NYS DOH Photo by M. Behr



NWHC Cold Isolate
Photo by D. Blehert, NWHC



Fungal Biology - Mycology

- Requires cold for growth.
- It cannot grow at room temperature.
- Common on sick bats.
- Absent from healthy bats.
- All isolates are identical.
- Fungus is a new species, Geomyces destructans.

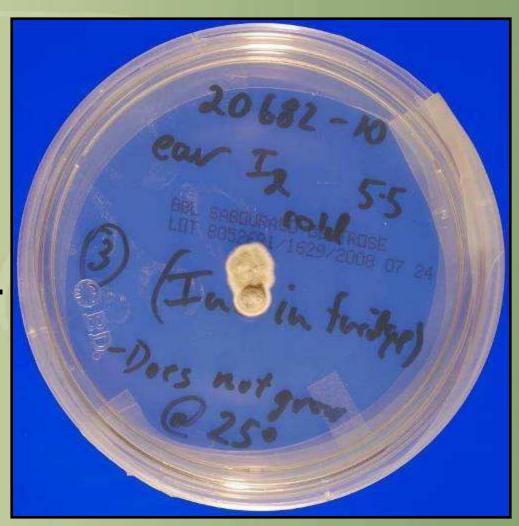




Photo by A. Klein, NWHC

G. destructans Growth Rates

• 3°C: 0.18 mm/day

• 7°C: 0.50 mm/day

• 14°C: 0.98 mm/day

• 23°C: No Growth

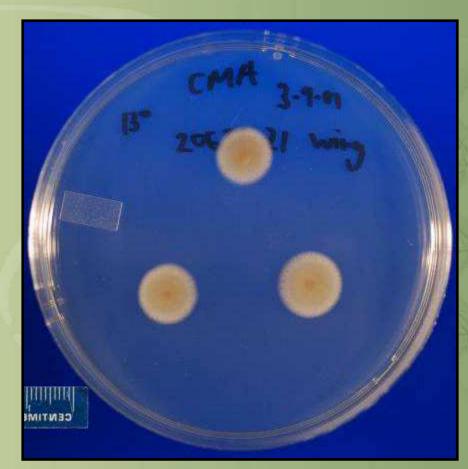


Photo by D. Berndt, NWHC

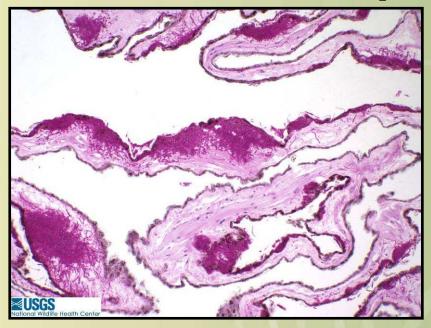


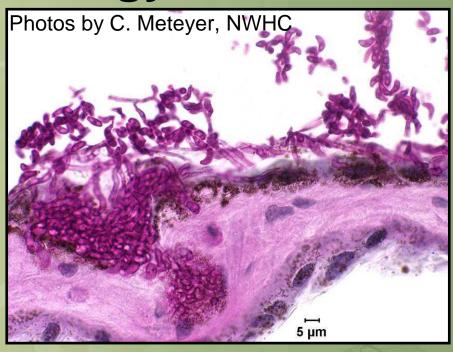
Diagnostic Assays for WNS

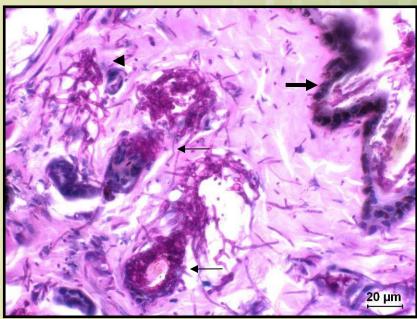
- Fungal culture
- Fungal tape strip
- PCR/DNA sequencing
- Histopathology "gold standard"
- **Future**
 - Tissue immunohistochemistry



Histopathology



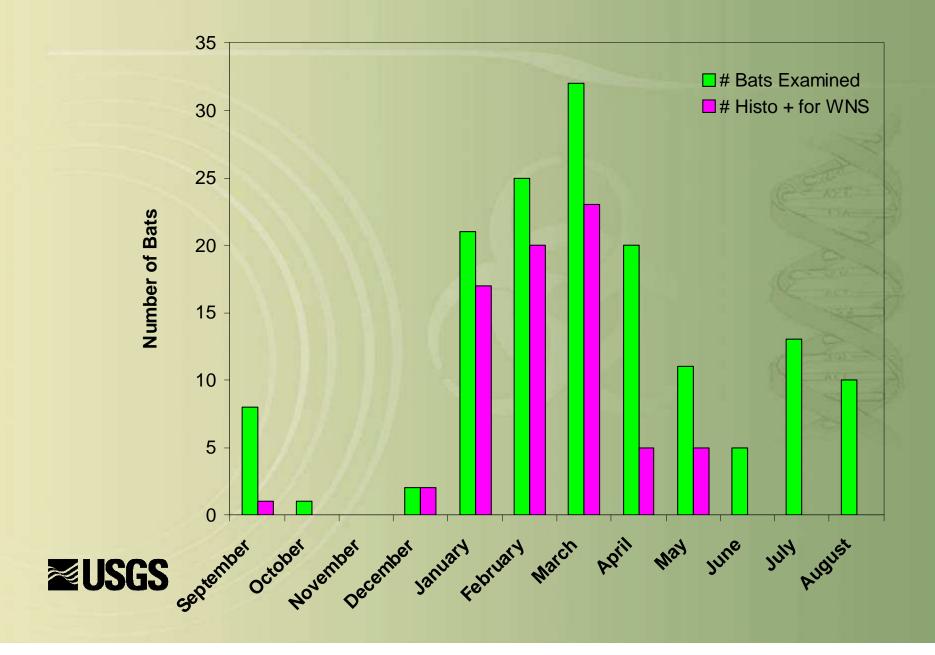




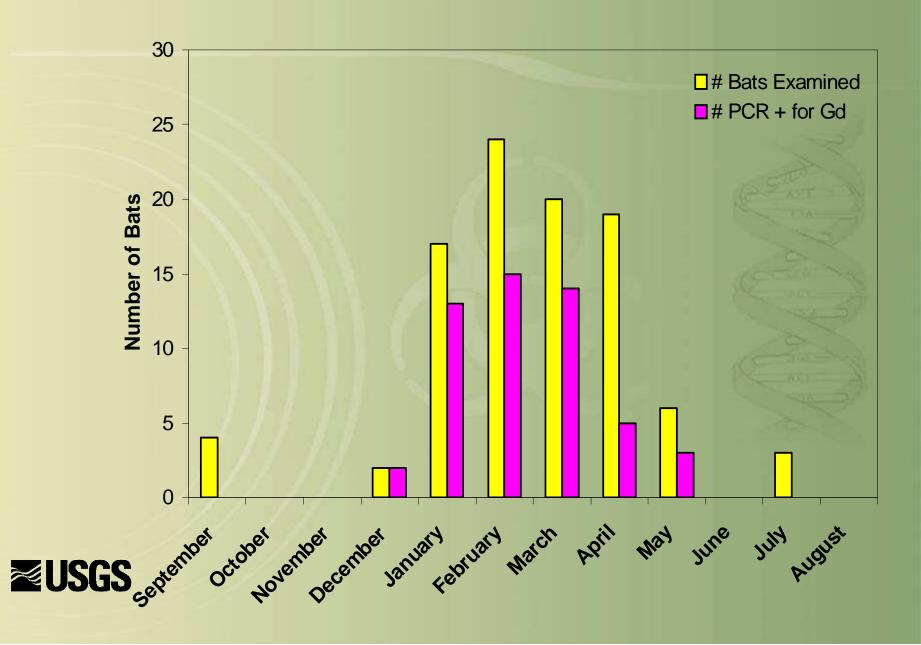
Bat Wings – In addition to flight, they are critical for:

- Heat Dissipation
- Water Control
- Gas Exchange
- Blood Pressure Regulation

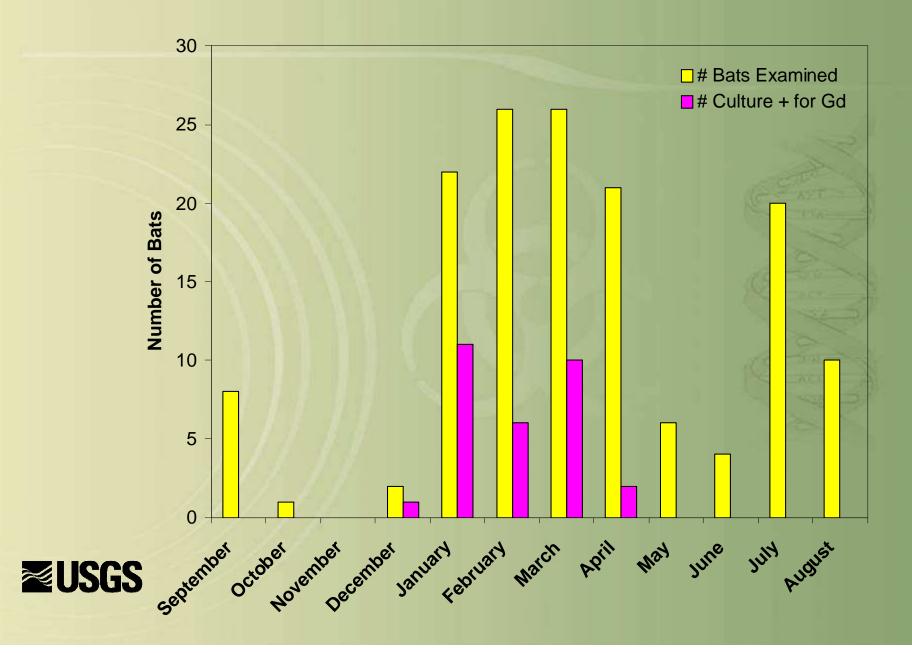
WNS Histopathology Analyses by Month (2008-2009)



G. destructans PCR Analyses by Month (2008-2009)



G. destructans Culture Analyses by Month (2008-2009)



Lab Confirmation of WNS

Earliest case: Sept 30 (histo only)

Latest case: May 21 (histo, PCR)

Incubation period: unknown

- Fungal growth
 - field observations ~2-3 wk
 - experimental ≤12 wk
- Mortality 8 wk- >1 yr



Species Affected by WNS

Little brown	67/124	54.0%
Big brown	3/35	8.6%
Eastern pipistrelle	10/19	52.6%
Northern long-eared	11/14	78.6%
Indiana	3/6	50.0%
Eastern small-footed	1/1	100%

PCR+ only



Demographics of WNS

 Female
 37/95
 38.9%

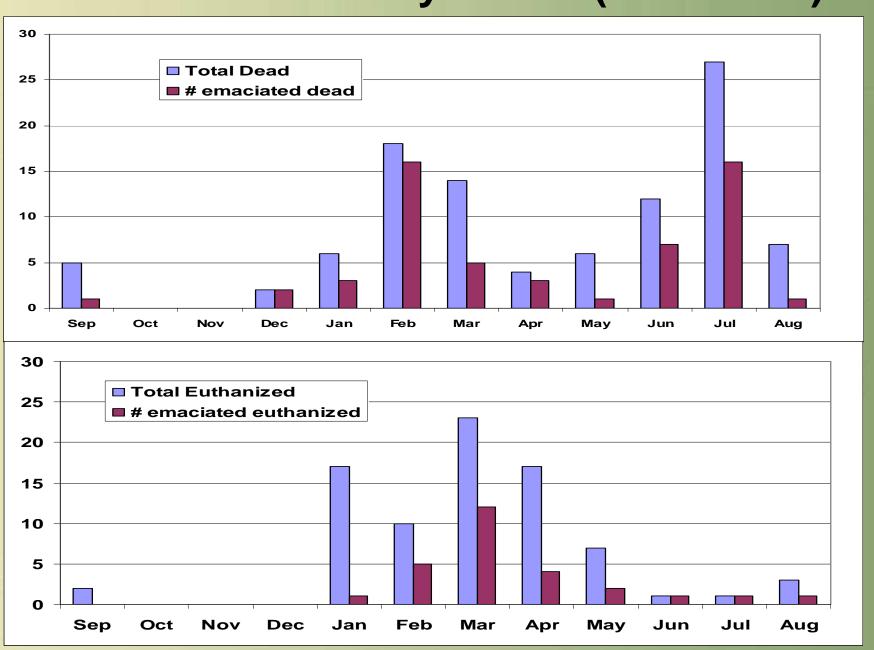
 Male
 52/105
 49.5%

Earliest age of onset: ~6 mo





Emaciated Bats by Month (2008-2009)



Linking field observations to lab results

- 50.6% (41/81) WNS+ bats were emaciated
- 41.8% (23/55) of sites testing WNS+ had no signs of bat mortality
- 30.1% (22/73) bats lacking visible evidence of fungus in the field tested WNS+



WNS Transmission Study

- Torpid little brown bats housed in mesh enclosures in refrigerators at 7°C.
- Three treatment groups each in an individual refrigerator in a dedicated animal isolation room.



Infection Trial – Treatment Groups

Group 1:

Control/Sham Treatment (WI LBBs)

16 WI LBBs + Buffer 16 WI LBBs + Buffer + Abrasion

0/31

Group 2:

Geomyces destructans spore treatment (WI LBBs)

15/16

16 WI LBBs No Abrasion 1/15

16 WI LBBs

(Aerosol Control)

14/16

16 WI LBBs
Abrasion

Group 3:

Bat-to-Bat Contact Infection (NY + WI LBBs)



9/10

8 WI LBBs 8 NY LBBs No Abrasion 1/8

16 WI LBBs

(Aerosol Control)

3/8

8 WI LBBs 8 NY LBBs Abrasion

Treatment Evaluation of Captive Bats

- Collaboration with licensed rehabilitator, NJ F&G, USFWS, NWHC, and Cornell
- 3 groups (control, single vinegar application, multiple vinegar application)
- Wing photos, histology, fungal culture & PCR

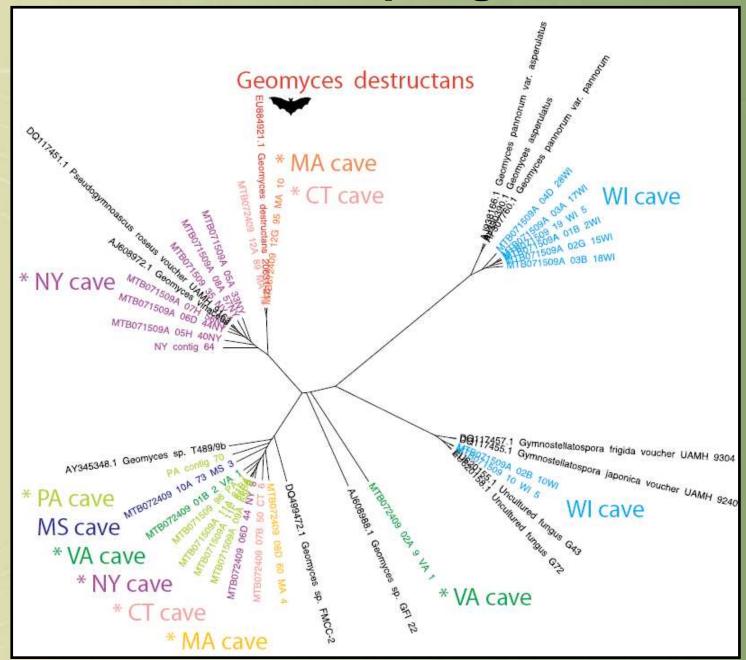


Cave Sediment Sampling Project

- Collected 550 sediment samples from 120 caves in the eastern US.
- Screen samples by PCR for Geomyces destructans.



Environmental Sampling Results





Current Sampling Strategies

- Any unusual or greater than expected bat mortality throughout the year
 - Define locally
- Winter (Nov-May)
 - WNS affected areas
 - Counties adjacent to WNS areas
 - WNS-free areas



Current Sampling Strategies

- Summer (Jun-Sep)
 - Limited number of bats with 2+ wing lesions from select WNS+ areas
 - Bats with suspicious fungus from any state
 - Punch biopsies from listed species with 2+ wing lesions
 - Bats banded in WNS affected areas with wing lesions captured in unconfirmed states
 - Photos only from live bats with 2+ wing lesions in unconfirmed states
- Fall (Oct)
 - Limited number of bats from confirmed WNS+ sites



Acknowledgments

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